BOOK REVIEWS

CONWAY MORRIS, S. 2003. *Life's Solution. Inevitable Humans in a Lonely Universe*. xxi + 464 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £18.95, US $30.00 (hard covers). ISBN 0 521 82704 3.
DOI: 10.1017/S0016756804219628

As is often the case, the subtitle of this book carries the main message: given the presence of life on our planet the evolution of something like humans is inevitable, but none the less the number of planets in the universe fit for life, and on which life is present, may be very limited indeed. Perhaps, even, there is only the one. The two halves of that statement sound paradoxical, so how does Simon Conway Morris arrive there?

The main part of the book presents numerous examples of evolutionary convergence: of similar biological solutions evolved under adaptational pressures more than once, sometimes many times – often, apparently, from very different starting points. It is a fascinating tale, ranging across the entire field of living organisms: for example, in animals of convergent evolution of sabre teeth in both placental cats (the sabre-tooth felids) and marsupials (the thylacosmilids); in insects the development of all-but identical forelimbs in the praying mantis and *Mantispa*; in fish, convergence in the morphology of a wide range of pike; and in the plant kingdom the barely distinguishable stems resulting from convergent evolution in the unrelated desert plants of a New World cactus and a Kenyan spurge. And that's just a sample. But more intriguingly, many of the sensory organs of widely different organisms have also evolved independently, sometimes many times over. The camera-like eye is a classic example, but so are such features as hearing, echolocation and a sense of smell. More controversially, perhaps, Conway Morris suggests that activities such as agriculture, social structures, even advanced culture may have evolved convergently, and not only in humans (though we often like to think we are the only true repository of such 'higher' functions).

Given the huge number of combinations possible in the game of evolution from even a relatively small number of life's building blocks, why, one might ask, should there be such a limited number of successful outcomes that the same solutions appear time after time via different evolutionary pathways? Why is convergence so common? The answer seems to be that only a relatively small number of solutions in biological space can actually do the job, and an even smaller number can do it so well that they thrive and survive. Perhaps it's not so surprising. An example that comes to mind is the hugely successful American Jeep developed during World War II. All the jeeps used a limited number of interchangeable parts, even those built in different factories and by different companies. You could unbolt a body panel and bolt it on somewhere else. Yet although there is a huge number of ways of rearranging and bolting together all the component parts of a jeep, there is only a limited number that would actually work. At the end of the day, to have a successful vehicle you still need much the same engine, still need wheels and a way of steering and controlling the vehicle. In the same way it appears that viable and effective biological space is relatively limited, and is quickly (and repeatedly) sampled by the pressures of adaptive selection on evolving organisms.

One of the great divisive arguments is between those who maintain that the particular organisms that fill the biosphere now are the happenstance result of chance occurrences throughout their evolutionary history, and those who say that however many times you keep getting knocked back, however many times you re-run the tape of evolution, you would keep ending up with similar results, simply because the field of viable, successful organisms is relatively small and evolution rapidly samples the whole available space. The argument becomes most pointed, of course, where humans themselves are concerned. If the tape of life were re-run, would the result be something quite different – a world ruled by aquatic creatures, perhaps, since water covers 70% of the globe – or would the result be something much like the humanoids we know and love? Conway Morris is firmly on the side of the latter, as you have already guessed from the title of his book. And he marshals an impressive and extremely wide-ranging array of arguments to support his case, from the microstructure of proteins and DNA at one end, to the large-scale processes in stars and galaxies at the other.

It is hard to avoid a sense of awe as you are reminded again in this book of the pervasiveness, the power, the sheer stickability of life on this planet, come what may. From the time of almost the oldest known rocks on Earth, nearly 4 billion years ago, there is evidence that life was present. And it's never let go. Apparently life needed that long history gradually to develop and adapt until it underwent the famous explosion in the Cambrian, less than 600 million years ago. From that time, perhaps even from the emergence of the first reproducing life forms, maybe humans were inevitable. But no-one knows how that initial leap was made from organic molecules to self-sustaining life. Presumably the conditions were extremely special. That, at least, might lead one to think that life elsewhere in the universe may be extremely rare. Or even non-existent. But once that leap had been made the rest, as they say, is history. That's how Conway Morris can maintain the likelihood of inevitable humans in a lonely universe.

For some this will lead to metaphysical questions. The frailty or even near-impossibility of getting life going except when exactly the right conditions prevail, coupled with the apparent robustness and near-inevitability of something like humans then evolving from that life, certainly fits in robustly with the Judeo-Christian view of a created order. But if your metaphysical assumptions are of meaningless chance occurrences, of physical interactions without any driving or ordering intelligence behind them, then they too will accommodate the scientific observations. Are we here by design or chance? The choice of which to believe is yours.

This is a fascinating book covering a huge range of evidence. Biologist or not, I recommend it. After all, we are all human and the question of our origins has to be one of the more important in the world. There is much here to stimulate those famously large brains with which humans are endowed.

Robert S. White

STEPHENSON, D., LOUGHLIN, S. C., MILLWARD, D., WATERS, C. N. & WILLIAMSON, I. T. 2002. *Carboniferous and Permian Igneous Rocks of Great Britain North of the Variscan Front*. Geological Conservation Review Series Volume 27. xviii + 374 pp. Peterborough: Joint Nature Conservation Committee; distributed by NHBS Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Price £74.00 (hard covers). ISBN 1 86107 497 2.
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This beautifully produced hard-back volume provides a detailed account of the myriad of igneous rocks related to back-arc extension during the Carboniferous Period, followed by the intracontinental rifting events of the Permian Period, north of the Variscan Front within Great Britain. These volcanic and intrusive rocks crop out over a large area, from the Orkney Islands in the north, to Derbyshire in the south, although it is within the Midland Valley of Scotland that they are most abundant. Site-selection criteria are presented, comprising the factors international importance, presence of exceptional features, and representativeness.

All aspects of these rocks are dealt with, including introductory sections on history of research, tectonic setting, magma source and age. A useful figure at the beginning of the volume summarizes the nature, distribution and age of each significant occurrence. A table lists each site, along with the relevant selection criteria.

The authors have compiled a huge database and present the information in a logical and digestible format. Ordnance Survey grid references are provided for each site, with helpful introductory comments, followed by separate sections with descriptions, interpretation, and conclusions. A uniformly good set of maps accompanies the site descriptions, together with high-quality black-and-white photographs illustrating both general and detailed aspects of the igneous rocks. The authors give full recognition to the geologists who provided the first descriptions of the rocks and, as such, we are also given a historical perspective on the interpretation of each site. Geochemical and petrographic aspects are (sensibly) commented upon, with a few data plots and photomicrographs included, but are not gone into at length. A glossary of technical terms is provided to assist the non-specialist reader.

Although not designed as a field guide, I am sure that this volume will be consulted by geologists who are not familiar with these rocks and who wish to see them at first hand. Certainly, the field descriptions and maps are sufficiently detailed to lead you to the sites and to assist with gaining a good understanding as to what can be seen. Furthermore, the volume has an extensive reference list, important to those not familiar with the literature.

After the introductory (first) chapter, each of the succeeding six chapters deals with specific groupings of rocks, based upon their geographic distribution and/or their age. This layout is useful, in that it allows the reader to find information on a particular area, or on rocks of a specific age, relatively easily. Furthermore, one gets the feeling that the length of the text and the inclusion of figures was decided upon not by some editorial decree, but rather by how much space was actually needed adequately to present the data. The layout of the text is generous and the overall print quality is good.

The stated aim of the Geological Conservation Review (GCR) series is ' . . . to provide a public record of the features of interest and importance at localities already notified or being considered for notification as 'Sites of Special Scientific Interest' (SSSIs)'. The obvious value of books within the GCR Series is to capture in one place widely dispersed data, and to provide a uniform review prepared by experts, which may be used by interested specialists and non-specialists. This volume successfully achieves this goal and will, I am sure, be consulted for many years to come.

Brian Bell

VAN RENSBERGEN, P., HILLIS, R. R., MALTMAN, A. J. & MORLEY, C. K. (eds) 2003. *Subsurface Sediment Mobilization*. Geological Society Special Publication no. 216. vi + 522 pp. London, Bath: Geological Society of London. Price £95.00, US $159.00; members' price £47.50, US $79.00; AAPG members' price £57.00, US $95.00; hard covers. ISBN 1 86239 141 6.
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The textbook distinction between the formation of sedimentary rocks and their later tectonic deformation has always been blurred by a range of phenomena involving the mobilization of 'soft' sediments, for example slump structures, sandstone intrusions, shale diapirs and mud volcanoes. These phenomena are regarded as anomalous by both sedimentologists and structural geologists and the study of them has therefore passed in and out of fashion with both groups. Surficial sediment slumps have perhaps had more attention than other structures, not least because their orientations provide vital data on the directions of basin palaeoslopes. Now Pieter Van Rensbergen and colleagues bring us a strong selection of papers focussing on phenomena where sediments have been remobilized or deformed in the subsurface by processes other than conventional tectonic deformation.

This collection derives from a conference on Subsurface Sediment Mobilization in September 2001. The 33 papers are grouped under three headings. One section is devoted to mobilization associated with the enigmatic polygonal fault systems increasingly evidenced from sedimentary basins. The other two sections cover shallow and deep subsurface mobilization. The wide range of phenomena and mechanisms includes load structures triggered by expelled pore water, fluidization pipes ascribed to rapid sea-level change, mud volcanism from gas hydrate formation, sand–bitumen breccias promoted by passage of fluid hydrocarbon, and many more. There is a good balance of onshore field observation, offshore seismic data and analogue or mathematical modelling. An introductory chapter by the editors makes a brave and partly successful attempt to provide a conceptual framework to these diverse ideas. Subsurface sediment mobilization is increasingly being recognized as an important factor in assessing hydrocarbon systems, and this volume is a valuable step forward in our understanding of the key processes.

The production standard of this Geological Society special publication is as high as ever, though the price of this series inevitably increases year-on-year. However, libraries will find this volume well used by academic and industry readers, and discounts to members of the London Geological Society and American Association of Petroleum Geologists bring the price down for personal buyers.

Nigel Woodcock